

Erwin Library & High School

Geothermal Study

Performed For

Erwin Utilities

by

Earth Energy

Engineering Inc.

April 1997

EARTH ENERGY

Engineering Inc.

Federal ID No. 54-1770369
TN Statewide Mech. Contractor No. 38861 CMC-C
P.O. Box 322
Big Stone Gap, Va. 24219

Bill Nagel - VP Engr
tel. (540) 523-2283
April 29, 1997

Lee H. Brown
Manager of Operations
Erwin Utilities
PO Box 201
Erwin, Tennessee 37650

Lee,

Please find enclosed the drill logs and results of the thermal conductivity study we performed at the proposed Erwin Library and High School locations.

Two 1" Phillips uniscoils were installed at the new site for the Erwin Library at a depth of 330 feet. ~~Five~~^{Four} inch steel casing was left imbedded in bedrock at 102 feet and the remainder of the hole drilled with a 4" hammer. The boreholes were grouted by means of a tremie pipe utilizing high solids bentonite grout. One loop was chosen for the thermal conductivity test and utilizing a Ewbank and Associates "suitcase" test unit we performed the test on February 27, 1997. The thermal conductivity was calculated as **1.43 Btu/hour/degree/foot**. This is an average of the entire borehole. All test methods, interpretations, and procedures were done in accordance with the

recommendations and guidelines of the International Ground Source Heat Pump Association.

A similar test was done at the site of the proposed Unicoi Co. High School on the morning of February 28, 1997. Here the loop was installed at a depth of 380 feet. 120 feet of casing was required to complete the hole, but was retrieved after loop insertion. The same method of grouting was used as above. Generator speed fluctuated somewhat accounting for observable temperature movements. The thermal conductivity was calculated as **1.54 Btu/hour/degree/foot**.

For reference, thermal conductivity of various materials is shown below:

- | | |
|---------------------|-----|
| 1. Dense rock | 2.0 |
| 2. Average rock | 1.4 |
| 3. Dense concrete | 1.0 |
| 4. Solid masonry | .75 |
| 5. Heavy soil, damp | .75 |
| 6. Heavy soil, dry | .50 |
| 7. Light soil, damp | .50 |
| 8. Light soil, dry | .20 |

Thermal conductivity values along with monthly heating/cooling loads for the building and specified equipment efficiency ratings will allow the thermal field to be accurately and economically designed for optimum performance.

A total of four holes were drilled at the High School site. Two were successful and have loops inserted to the depth of 380 feet. Two others were abandoned at 126 feet and 99 feet when mud seams and cobble prevented advancement and the insertion of casing. This field will be usable as a geothermal heat exchanger but will likely require more costly underreaming, drilling methods.

We at Earth Energy Engineering appreciate the opportunity to be of service to you and have really enjoyed working with you. Please call if we can be of further assistance.

EARTH ENERGY

Engineering Inc.

P.O. Box 322

Big Stone Gap, VA 24219

(540) 523-2283

Drill log information

Core drill location: Erwin Train Station Boring # 1
State: Tennessee
County: Unicoi
Started: 1-14-97
Finished: 1-16-97
Driller: Byrd Hensley

Depth		Thickness	Description
From	To		
0'	29'	29'	Sand, Soil, & Pebbles
29'	33'	4'	Boulders
33'	74'	41'	Void (Water) Sand & Pebbles
74'	76'	2'	Limestone
76'	86'	10'	Void (Water) Sand & Pebbles
86'	87.5'	1.5'	Angular Rock Bedding (Limestone)
87.5'	90'	2.5'	Limestone
90'	130'	40'	Limestone (Hard) Dolomite
130'	132'	2'	Mud Seam (Arquillaceous Limestone)
132'	167'	35'	Fracture Zone (Water 3 GPM)
167'	223'	56'	Limestone (Hard) Dolomite
223'	224.5'	1.5'	Fracture Zone (Arquillaceous Limestone) Mud w/ Sand
224.5'	360'	135.5'	Limestone
360'	379'	19'	Fracture Zone (Limestone) Dolomite
379'	401'	22'	Limestone (Dolomite)
	401'	0'	Total Depth

EARTH ENERGY

Engineering Inc.

P.O. Box 322

Big Stone Gap, VA 24219

(540) 523-2283

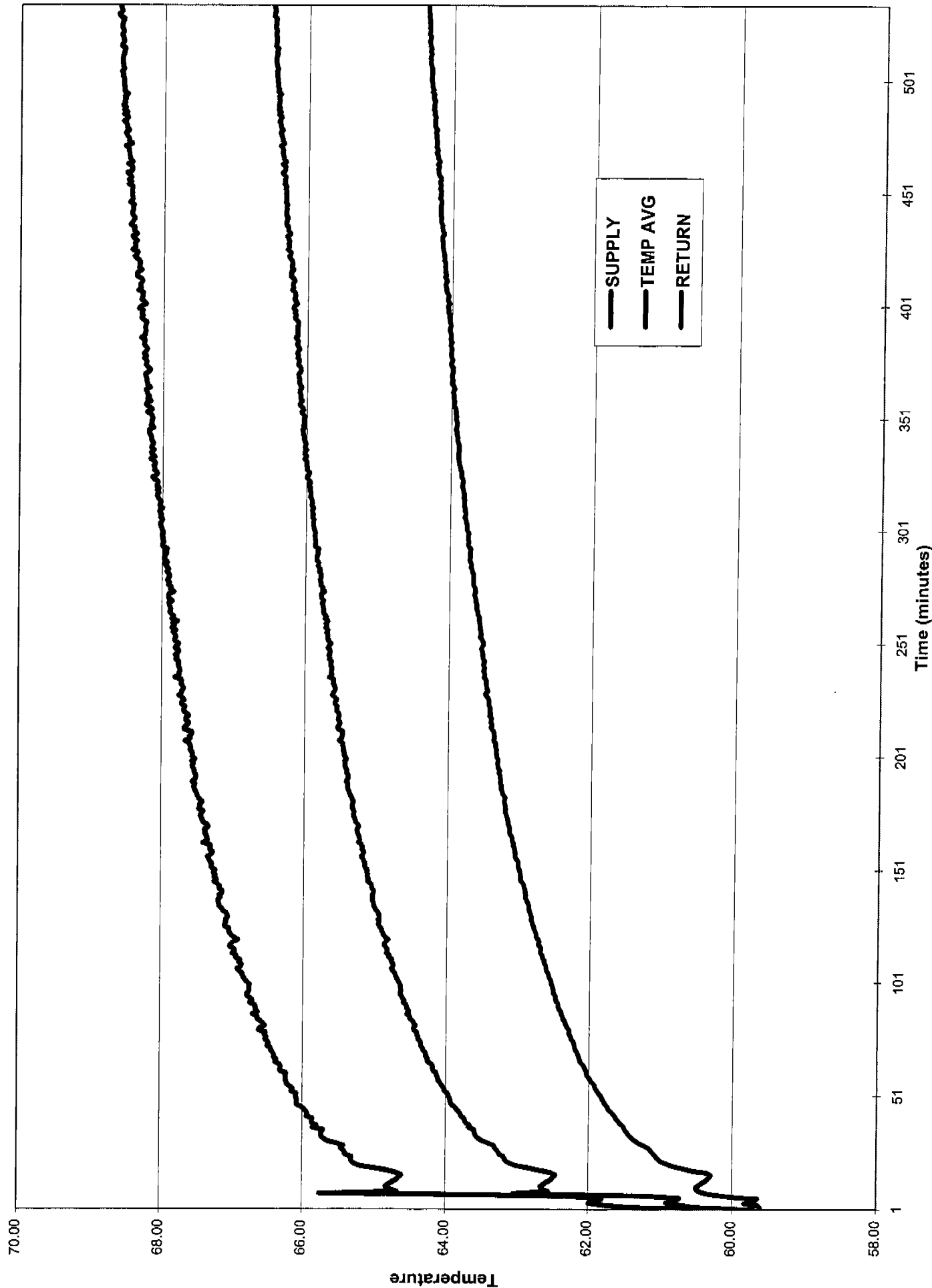
Drill log information

Core drill location: Erwin Train Station Boring # 2
State: Tennessee
County: Unicoi
Started: 1-21-97
Finished: 1-22-97

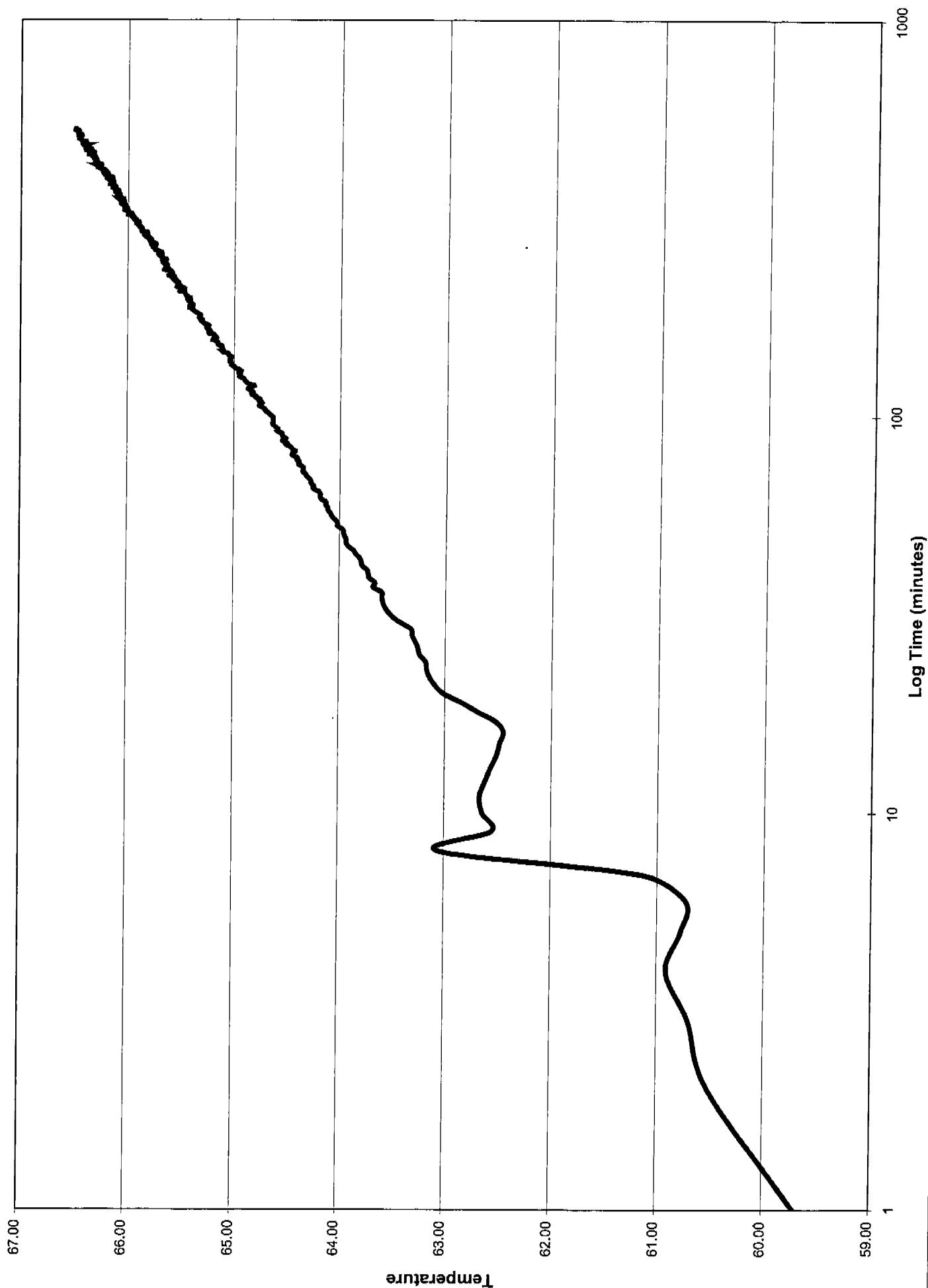
Depth		Thickness	Description
From	To		
0'	90'	90'	Clay, Gravel, Large Cobbles, & Voids
90'	130'	40'	Limestone (Hard) Dolomite
130'	131'	1'	Mud Seam w/ Void (Arquillaceous Limestone)
131'	169'	38'	Fracture Zone (Water) 15 GPM
169'	222'	53'	Limestone (Hard) Dolomite
222'	224'	2'	Fracture Zone (Clay) (Arquillaceous Limestone)
224'	330'	106'	Limestone (Hard) Dolomite
330'	380'	50'	Fracture Zone (Arquillaceous Limestone)
			Flowing Sand w/ Water 20 GPM Quartz Gravel (Heavy Sand)
380'	385'	5'	Limestone (Hard) Dolomite
385'	398'	13'	Fracture Zone (Limestone) Small Gravel & Sand

Note: Sand & gravel heaving up bore hole to 330'

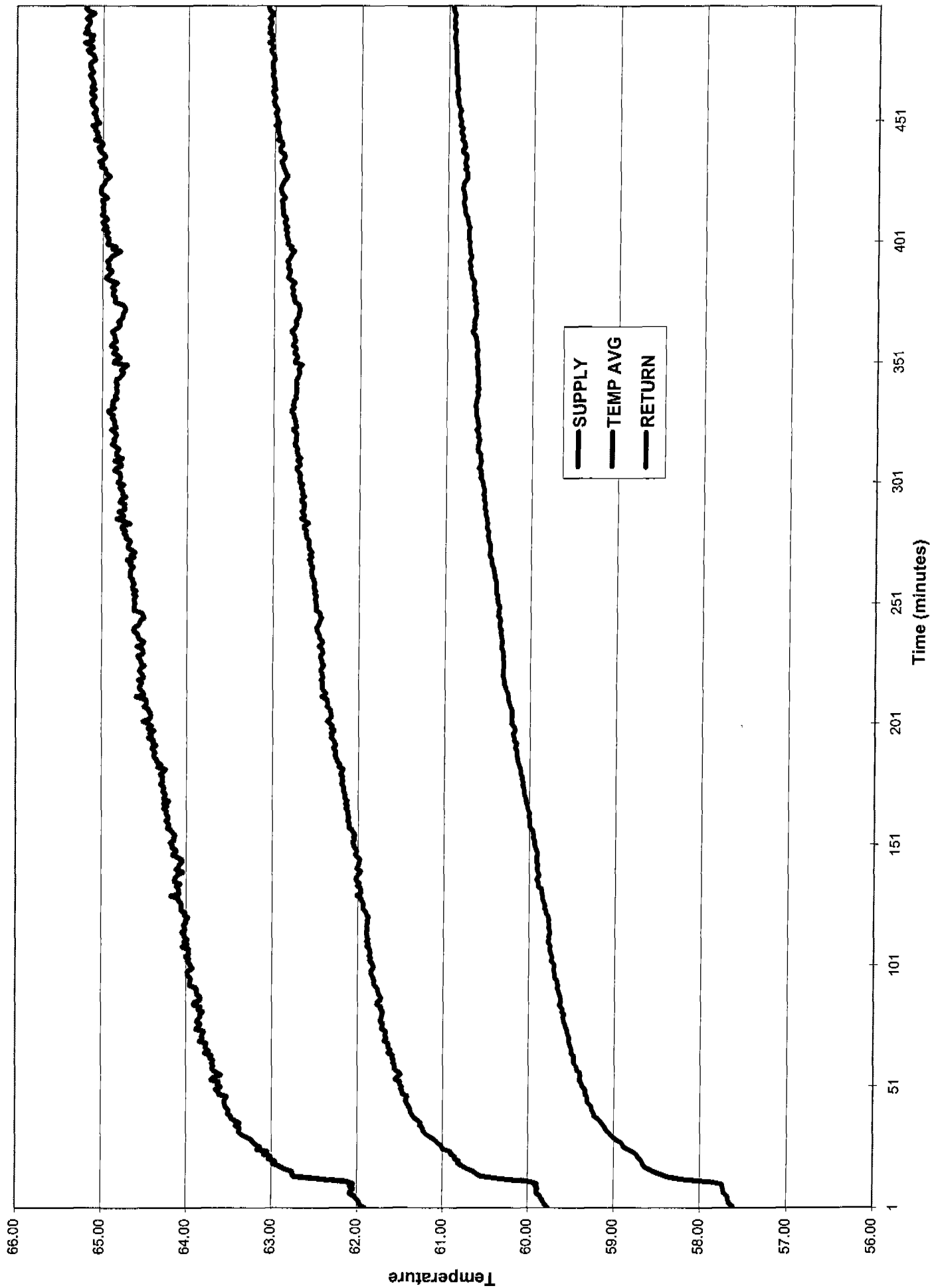
Erwin Li
Thermal Conductivity Test
Graph of Supply, Temp Avg, Return



Erwin Lil
Thermal Conductivity Test
Graph of Log Time of Temp Avg



Unicoi Scl
Thermal Conductivity Test
Graph of Supply, Temp Avg, Return



Unicoi S
Thermal Conductivity Test
Graph of Log Time of Temp Avg

